

REMARKS

Claims 1, 7, 13, 19, 21-22 and 24 are rejected under 35 U.S.C. §102(b) as being clearly anticipated by Wang et al. (U.S. 6,387,806 dated 5/14/2002).

Wang et al. discloses an annealing process performed to convert a concave top surface of a copper wiring to a convex top surface after performing a CMP process.

Referring to Figures 14 and 15, related col. 9, lines 9-65 of Wang, et al., Wang, et al. discloses a recess 228 formed on the top of surface of the copper fill 230 by a CMP process. Thereafter, a second copper alloy 232 is deposited to fill the recess 228. Wang does not teach or suggest applicant's claimed annealing process.

In the present invention, a copper anti-diffusion insulating film 200 is formed on the entire structure including the convex top surface of the copper wiring (see specification, top of page 8). For this reason, a surface of the entire structure comes to be flat. However, a copper anti-diffusion insulating or encapsulating film 222 of Wang, formed of metal dopant separated from the copper alloy 232 (see Figs. 12, 13 and col. 9, lines 59-63) during the thermal annealing process, is formed of a conductive material, e.g., tantalum, calcium, cerium or zirconium. Furthermore, the copper anti-diffusion insulating film 222 results in a height difference (see Figs. 12, 13).

As described in paragraph [0009] of applicant's specification, and with reference to Prior Art Fig. 1, it is precisely at the interface of the copper anti-diffusion conductive film 15 and the copper anti-diffusion insulating film 100 where defective wiring is found in prior art semiconductor devices. Applicant's copper anti-diffusion insulating film 200 formed on the entire structure (see Fig. 2C), including the convex top surface of the copper wiring (26), resulting in a flat upper surface of the entire structure, alleviates the prior art copper diffusion.

Since the Wang et al. reference neither teaches nor suggests forming applicant's copper anti-diffusion insulating film on the entire structure to provide a flattened surface of the entire structure, it is submitted that Claims 1, 7, 13, 19, 21-22 and 24 are clearly distinguishable from Wang.

Claims 13, 15, 19, 21, 23 and 25 are rejected under 35 U.S.C. §102(e) as being clearly anticipated by Saito et al. (US 2003/0109129, dated 6/12/2003, filed 12/27/2002).

Saito et al. '129 discloses an anti-polishing layer formed on an interlayer insulating film. In addition, a top surface of a copper wiring has a lowermost portion disposed below the top surface of the interlayer insulating film, after a CMP process.

However, in Saito, a top surface of a copper wiring has a lowermost portion disposed above the top surface of the interlayer insulating film. Applicant's claim 13 (and claims 15, 19, 21, 23 and 25 dependent thereon) call for the top surface of the copper wiring to have a lowermost portion disposed below a top surface of the interlayer insulating film.

Meanwhile, the Examiner points out that Saito discloses an annealing process performed after performing a CMP process.

The annealing process is performed again and again in semiconductor manufacturing processes. However, the result of the annealing process is varied according to the purpose of the annealing process.

The result of the annealing process of Saito is different from the present invention, even if Saito teaches that the annealing process is performed after performing the CMP process. Namely, Saito does not teach or suggest that the concave top surface of the copper wiring changes to a convex top surface by the annealing process (*see* specification paragraph [0038], as well as Figs. 3A and 3B) in order to minimize surface energy due to heat.

Therefore, Applicant believes that claims 13, 15, 19, 21, 23 and 25 are clearly distinguishable from Saito.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

Applicant believes no fee is due with this response. However, if a fee is due, please charge our Deposit Account No. 13-2855, under Order No. 29936/39889 from which the undersigned is authorized to draw.

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Respectfully submitted,

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